6021

MEDIUM-MU TWIN TRIODE

SUBMINIATURE TYPE

PREMIUM TYPE 6021

Intended for applications at altitudes up to 60,000 feet where dependable performance under shock and vibration is paramount

GENERAL DATA

Electrical:

Heater, Pure Tungsten, for Unipotential Cathodes:

Voltage	6.3	ac or dc volts
Current	0.3	amp

Direct Interelectrode Capacitances:

	Without External Shield	*With External Shield*°	
Grid to plate (Each unit)	1.5	1.4	μμf
Grid to cathode and heater (Each unit)	2.4	2.1	μμf
Plate to cathode and heater (Unit No.1)	0.28	1.3	μμf
Plate to cathode and heater (Unit No.2)	0.32	1.4	μμf
Grid to grid	0.013 max.	0.011 max.	μμf
Plate to plate	0.52 max.	0.33 max.	μμf

Characteristics, Class A_1 Amplifier (Each Unit):

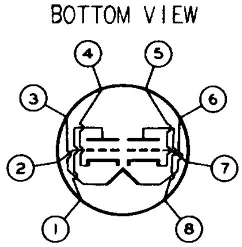
Plate-Supply Voltage	100	volts
Cathode Resistor	150	ohms
Amplification Factor	35	
Plate Resistance (Approx.)	6500	ohms
Transconductance	5400	μmhos
Plate Current	6.5	ma
Grid Voltage (Approx.) for plate current of 10 μa	−6.5	volts

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	1-3/8"
Length, Bulb Seat to Bulb Top (Excluding tip)	1.075" ± 0.060"
Diameter	0.366" to 0.400"
Dimensional Outline	*See General Section*
Bulb	T3
Leads, Flexible	8
Length	1-1/2" to 1-3/4"
Orientation and diameter	*See Dimensional Outline*

BOTTOM VIEW

Lead 1 – Plate of Unit No.2
Lead 2 – Grid of Unit No.2
Lead 3 – Heater
Lead 4 – Cathode of Unit No.2



Lead 5 – Cathode of Unit No.1
Lead 6 – Heater
Lead 7 – Grid of Unit No.1
Lead 8 – Plate of Unit No.1

°: See next page.

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AMPLIFIER — Class A_1

Values are for Each Unit

Maximum Ratings, *Absolute Values:*

For Operation at Altitudes up to 60,000 Feet

PLATE VOLTAGE	165 max.	volts
GRID VOLTAGE:		
Positive bias value	0 max.	volts
Negative bias value	55 max.	volts
PLATE CURRENT	22 max.	ma
GRID CURRENT	5.5 max.	ma
PLATE DISSIPATION	1.1 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	200 max.	volts
Heater positive with respect to cathode	200 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	220 max.	°C

Maximum Circuit Values:

Grid-Circuit Resistance:		
For cathode-bias operation	1.1 max.	megohms

° With external shield having inside diameter of 0.405" connected to cathode of unit under test.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Values are for Each Unit (Other unit connected to ground) and are Initial, Unless Otherwise Indicated

	Note	Min.	Max.	
Heater Current	1	0.28	0.32	amp
Heater Current at 500 hours	1	0.276	0.328	amp
Direct Interelectrode Capacitances:				
Grid to plate	2	1.2	1.8	μμf
Grid to cathode and heater	2	1.8	3	μμf
Plate to cathode and heater (Unit No.1)	2	0.2	0.36	μμf
Plate to cathode and heater (Unit No.2)	2	0.22	0.42	μμf
Grid to grid	3	-	0.013	μμf
Plate to plate	3	-	0.52	μμf
Amplification Factor	1,4	30	40	
Plate Current (1)	1,4	4.5	8.5	ma
Plate-Current Difference Between Units	1,4	-	1.6	ma
Plate Current (2)	1,5	-	100	μa
Transconductance (1)	1,4	4450	6350	μmhos

Notes 1 to 5: See next page.

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	Note	Min.	Max.	
Transconductance (1) Change:				
With heater voltage reduced to 5.7 volts. .	4	-	15	%
Individual at 500 hours .	1,4	-	25	%
Average at 500 hours. . .	1,4	-	15	%
Average at 500 hours:				
With heater voltage reduced to 5.7 volts. .	4	-	15	%
Reverse Grid Current. . . .	1,6	-	0.3	μa
Reverse Grid Current at 500 hours	1,6	-	0.9	μa
Grid Emission Current . . .	7	-	-0.5	μa
Heater-Cathode Leakage Current:				
Heater 100 volts negative with respect to cathode.	1	-	5	μa
Heater 100 volts positive with respect to cathode.	1	-	5	μa
Heater-Cathode Leakage Current at 500 hours:				
Heater 100 volts negative with respect to cathode.	1	-	10	μa
Heater 100 volts positive with respect to cathode.	1	-	10	μa
Leakage Resistance:				
Between grid and all other electrodes tied together.	1,3,8	100	-	megohms
Between plate and all other electrodes tied together.	1,3,9	100	-	megohms
Leakage Resistance at 500 hours:				
Between grid and all other electrodes tied together.	1,3,8	50	-	megohms
Between plate and all other electrodes tied together.	1,3,9	50	-	megohms

Note 1: With 6.3 volts ac or dc on heater.

Note 2: Without external shield.

Note 3: Other electrodes connected to ground.

Note 4: With dc plate-supply voltage of 100 volts, cathode resistor of 150 ohms, and cathode-resistor bypass capacitor of 1000 μf.

Note 5: With dc plate voltage of 100 volts and grid voltage of -6.5 volts.

Note 6: With dc plate-supply voltage of 150 volts, cathode resistor of 300 ohms, and grid resistor of 1 megohm.

Note 7: With ac or dc heater voltage of 7.5 volts, dc plate voltage of 150 volts, grid voltage of -7.5 volts, and grid resistor of 1 megohm.

Note 8: With grid voltage of -100 volts.

Note 9: With dc plate voltage of -300 volts.

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SPECIAL RATINGS AND PERFORMANCE DATA

Shock Rating:

Impact Acceleration. . . . . 450 max. g

This test is performed on a sample lot of tubes from each production run. Tubes are held rigid and are tested in four different positions. At the end of this test, tubes will not show permanent or temporary shorts or open circuits, and are required to meet established limits for low-frequency vibration, heater-cathode leakage current, and transconductance change.

Fatigue Ratings:

Vibrational Acceleration . . . . 2.5 max. g

This test is performed on a sample lot of tubes from each production run. Tubes are rigidly mounted and subjected in each of three positions to 2.5 g vibrational acceleration at 60 cycles per second for 32 hours. At the end of this test, tubes will not show permanent or temporary shorts or open circuits, and are required to meet established limits for low-frequency vibration, heater-cathode leakage current, and transconductance change.

Variable-Frequency Vibration Performance:

This test is performed on a sample lot from each production run. Tubes are vibrated over the frequency range of 5 to 50 cps at a total excursion of 0.08" for 3 minutes. At the end of this test, tubes are required to meet established limits for low-frequency vibration, heater-cathode leakage current, and transconductance change.

Low-Frequency Vibration Performance:

RMS Output Voltage . . . . 50 max. mv

This test is performed on a sample lot of tubes from each production run under the following conditions: Heater voltage of 6.3 volts, plate-supply voltage of 100 volts, cathode resistor of 150 ohms, plate load resistor of 10000 ohms and vibrational acceleration of 15 g at 40 cps.

Heater-Cycling Life Performance:

Cycles of Intermittent Operation . . . . 2000 min. cycles

Under the following conditions: Heater voltage of 7.0 volts cycled one minute on and four minutes off, heater 140 volts rms with respect to both cathodes tied together.

Audio-Frequency Noise and Microphonic Performance:

RMS Output Voltage . . . . 65 max. mv

This test is performed on a sample lot of tubes from each production run under the following conditions: Heater voltage of 6.3 volts, plate-supply voltage of 100 volts, cathode resistor of 75 ohms, grid-No.1 resistor of 0.1

megohm, plate load resistor of 0.01 megohm, and cathode-bypass capacitor of 1000 μf. Units are connected in parallel. The output voltage of a tube, when tapped, will not cause a reading on a vu meter greater than that produced when a calibrating signal of 65 millivolts rms is applied to the plates of the tube.

Shorts and Continuity Test:

This test is performed on a sample lot of tubes from each production run. In this test a tube is considered inoperative if it shows a permanent or temporary short or open circuit, or a value of reverse grid current in excess of 1.0 microampere under the conditions specified in the Characteristics Range Values for reverse grid current.

1-Hour Stability Life Performance:

This test is performed on a sample lot of tubes from each production run to insure that the tubes have been properly stabilized. Conditions of life testing are specified under 500-Hour Intermittent Life Performance, except test run at room temperature. Tubes are initially read for transconductance (1). At the end of 1 hour, the value of transconductance (1) is read. The variation in transconductance (1) from the 0-hour reading will not exceed 15 per cent under the conditions specified in Characteristics Range Values.

100-Hour Survival Life Performance:

This test is performed on a sample lot of tubes from each production run to insure a low percentage of early inoperatives. Conditions of life testing are specified under 500-Hour Intermittent Life Performance, except test run at room temperature. At the end of 100 hours, a tube is considered inoperative if it shows a permanent or temporary short or open circuit, reverse grid current in excess of 1.0 microampere, or a transconductance (1) of less than 4000 micromhos under the conditions specified in Characteristics Range Values.

500-Hour Intermittent Life Performance:

This test is performed on a sample lot of tubes from each production run to insure high quality of the individual tube and to guard against epidemic failures of any of the characteristics indicated below. Life testing is conducted under the following conditions: Heater voltage of 6.3 volts, plate-supply voltage of 100 volts, heater-cathode voltage of 200 volts (heater positive with respect to cathode), cathode resistor of 150 ohms, grid resistor of 1 megohm and bulb temperature of 220° C. At the end of 500 hours, tube will not show permanent shorts or open circuits and will be criticized for the total number of

defects in the sample lot and for the number of tubes failing to pass established initial limits of heater current, individual, average, and 5.7-heater-voltage transconductance change, reverse grid current and heater-cathode leakage current shown under Characteristics Range Values.

OPERATING CONSIDERATIONS

The *heater supply* should be well regulated because life and reliability of the 6021 are adversely affected by departures from the 6.3-volt value. The extent to which life is affected is a function of the amount of these departures and their durations.

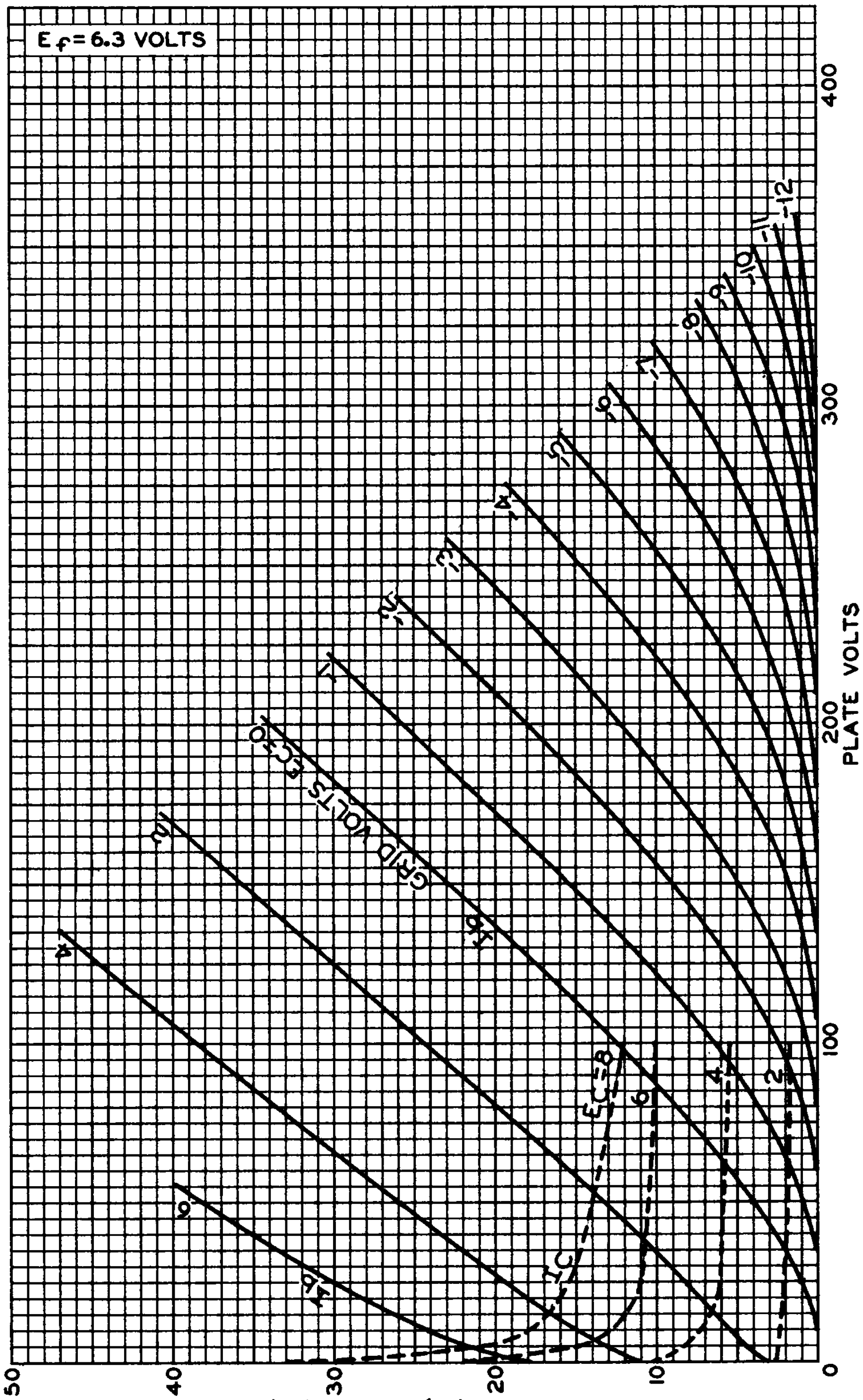
The *flexible leads* of the 6021 are usually soldered to the circuit elements. Soldering of the connections should be made as far as possible from the glass button. If this precaution is not followed, the heat of the soldering operation may crack the glass seals of the leads and damage the tube.

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AVERAGE CHARACTERISTICS

EACH UNIT



ELECTRON TUBE DIVISION

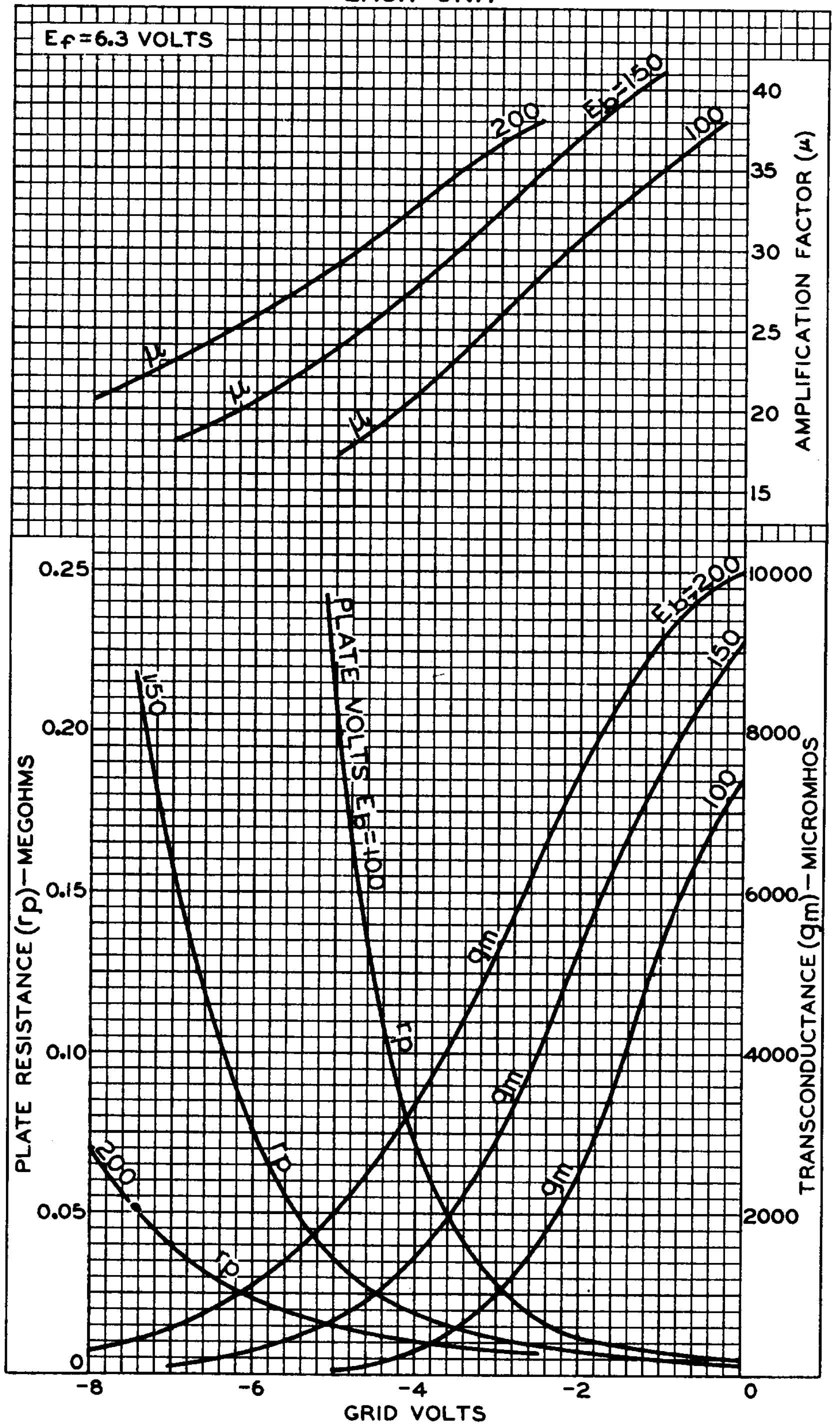
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AVERAGE CHARACTERISTICS
EACH UNIT



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